

U.S. DEPARTMENT OF COMMERCE
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PB80-115975

Particulate Measurement Efficiency of Pallflex T60A20 Filter Media

(U.S.) Environmental Protection Agency, Ann Arbor, MI

Jul 79

Technical Report

July 1979

Particulate Measurement -
Efficiency of Pallflex T60A20 Filter Media

by

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Emission Control Technology Division
Office of Mobile Source Air Pollution Control
Office of Air, Noise and Radiation
U.S. Environmental Protection Agency

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U. S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

TECHNICAL REPORT DATA <i>(Please read Instructions on the reverse before completing)</i>		
1. REPORT NO. SDSB 79-22	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE Particulate measurement-efficiency of Pallflex T60A20 filter media	5. REPORT DATE July 1979	6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Stulp, Kevin D.	8. PERFORMING ORGANIZATION REPORT NO.	
9. PERFORMING ORGANIZATION NAME AND ADDRESS Standards Development and Support Branch Office of Mobile Source Air Pollution Control U.S. Environmental Protection Agency Ann Arbor, MI 48105	10. PROGRAM ELEMENT NO.	11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS	13. TYPE OF REPORT AND PERIOD COVERED Technical	14. SPONSORING AGENCY CODE
15. SUPPLEMENTARY NOTES		
16. ABSTRACT An experiment designed to measure the efficiencies of different lots of Pallflex T60A20 teflon-coated glass fiber filters has been completed. Results of these tests indicated that: (1) batch-to-batch variation of filters is generally less than 2 percent, and (2) this media will not satisfy the 98 percent filter efficiency requirement on all vehicles. The test procedure specified in the light-duty diesel particulate NPRM requires: (1) a filter efficiency of 98 percent, or greater efficiency and (2) that fluoro-carbon-coated glass fiber filters must be used for testing. Some manufacturers have expressed concern that the 98 percent filter media efficiency requirement will be difficult to meet, and that there is significant batch-to-batch variability with this media. Hence, a brief test program was conducted to evaluate the significance of these concerns. Two different production vehicles were used to evaluate batch-to-batch variation of the above filters, and also to investigate difficulties in meeting the 98 per cent filter efficiency requirement.		
17. KEY WORDS AND DOCUMENT ANALYSIS		
a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Tests Fluorocarbon fibers Diesel engines Motor vehicles Teflon fibers	Particulate measurement Pallflex T60A20 Filter media Light duty vehicles Filter efficiency	
18. DISTRIBUTION STATEMENT unlimited	19. SECURITY CLASS (This Report) unrestricted	21. NO. OF PAGES 8p.
	20. SECURITY CLASS (This page) unrestricted	22. PRICE A02-A01

Abstract

An experiment designed to measure the efficiencies of different lots of Pallflex T60A20 teflon-coated glass fiber filters has been completed. Results of these tests indicated that: (1) batch-to-batch variation of filters is generally less than 2 percent, and (2) this media will not satisfy the 98 percent filter efficiency requirement on all vehicles.

Introduction

The test procedure specified in the light-duty diesel particulate NPRM (Federal Register, Vol. 44, No. 23, February 1, 1979) requires: (1) a filter efficiency of 98 percent, or greater efficiency and (2) that fluorocarbon-coated glass fiber filters must be used for testing. Currently, Pallflex Corporation is the only manufacturer of the required filter media, with the best candidate being type T60A20. Some manufacturers have expressed concern that the 98 percent filter efficiency requirement will be difficult to meet, and that there is significant batch-to-batch variability with this media. Hence, a brief test program was conducted to evaluate the significance of these concerns. Two different production vehicles were used to evaluate batch-to-batch variation of the above filters, and also to investigate difficulties in meeting the 98 percent filter efficiency requirement.

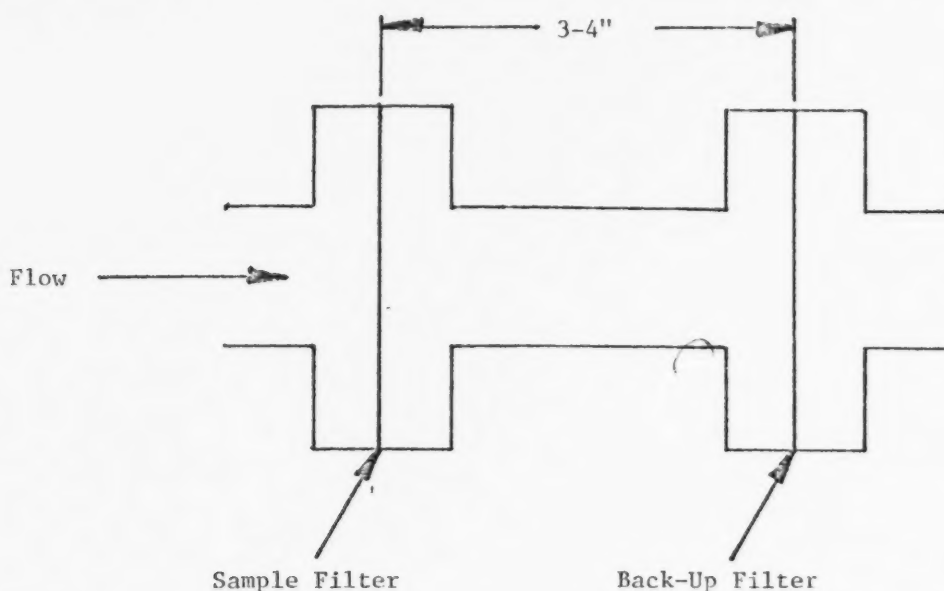
Objective

This study was conducted in order to evaluate batch-to-batch variation of Pallflex T60A20 filter media and to evaluate difficulties in satisfying the 98 percent filter efficiency requirement.

Test Procedure

In this investigation, the procedure specified for filter efficiency evaluation in the light-duty diesel NPRM (Federal Register, Vol. 44, No. 23, February 1, 1979) was followed. Therefore, only highlights will be noted.

This procedure requires that efficiency be determined by collecting particulate on a back-up filter while the vehicle is operated over a cold start LA-4 cycle. Filter efficiency corresponding to each bag must be determined. The back-up filter must be three to four inches behind the sample filter as shown below:



For this study, two diesel production vehicles were used to evaluate vehicle-to-vehicle effects on filter efficiency as well as the batch-to-batch variability.

Results

The results of this study (summarized in Table 1) indicate that filter efficiency is vehicle dependent, with generally small batch-to-batch variation.

Specifically, none of the batches of Pallflex T60A20 media satisfied the filter efficiency requirement when the Peugeot 504D was tested. The means of filter efficiency ranged from a low of 90.7 percent to a high of 93.7 percent with an overall mean and standard deviation of 92.1 and 0.9 percent respectively for all batches combined.

For the 1978 Oldsmobile Delta 88 350D, the Pallflex media met the 98 percent filter efficiency standard with each bag and batch combination, the low mean being 98.0 percent, the high mean being 99.2 percent, and the overall mean of 98.8 percent (with a standard deviation of 0.4 percent).

These results indicate relatively consistent batch-to-batch efficiency with Pallflex filters on multiple tests on a given vehicle.

Table 1

T60A20 Pallflex Filter Test Media

Peugeot 504D

<u>Batches</u>	<u>Filter Efficiency</u> ~ %		<u>Standard Deviation</u> ~ %		<u>Number of Tests</u>	
	<u>Bag 1</u>	<u>Bag 2</u>	<u>Bag 1</u>	<u>Bag 2</u>	<u>Bag 1</u>	<u>Bag 2</u>
3991E2	91.99	91.70	1.26	2.55	5	5
1092B	91.42	93.74	3.22	2.32	2	2
4009E2	90.71	93.49	0.73	0.45	2	2

Oldsmobile 350D

<u>Batches</u>	<u>Filter Efficiency</u> ~ %		<u>Standard Deviation</u> ~ %		<u>Number of Tests</u>	
	<u>Bag 1</u>	<u>Bag 2</u>	<u>Bag 1</u>	<u>Bag 2</u>	<u>Bag 1</u>	<u>Bag 2</u>
3991E2	98.01	98.44	0.12	0.49	2	2
1092B	99.06	99.13	0.15	0.09	2	2
4009E2	98.96	99.16	0.12	0.49	2	2

Note: Filter efficiencies calculated according to Section 86.110-81(c)(iv) Federal Register, Vol. 44, No. 23, February 1, 1979.

Discussion and Conclusion

The results indicate that while batch-to-batch variability is not expected to be a problem, some manufacturers may have difficulty in achieving a 98 percent filter efficiency using the Pallflex T60A20 media. This means that it is possible that the filter requirements, as specified in the NPRM, may be inequitable for those manufacturers that can achieve 98 percent efficiency. Therefore, some modifications to the test procedure may be required.

Possible options are:

1. Allow each manufacturer to select a filter of their choice and require a demonstration of minimum performance. However, there is a major difficulty with this modification. EPA would have to either use several different filter media types in order to maintain lab-to-lab correlation, or choose one filter type and let lab-to-lab correlation suffer. Neither are satisfactory.

2. Require a test-by-test efficiency correction based on one or more back-up filters. There may be inherent difficulties with this modification, also, as some researchers feel efficiency is load dependent, and hence the back-up filter may be far less efficient than the sample filter. There is then some uncertainty associated with the efficiency of the back-up filter which would have to be reconciled since its measurement cannot be ascertained precisely in day-to-day certification testing.

3. Lower the minimum acceptable filter efficiency. However, even with a reduction to as low as 95 percent, the Peugeot would still have trouble when Pallflex T60A20 filter media is used. While helpful, further modification would still have to be made.

4. Require a back-up filter during the certification test. The combined weight of both filters would be used in determining particulate emissions for those tests in which the calculated efficiency is below the specified minimum. This modification has the advantage of being relatively easy to use in day-to-day testing.

Recommendation

On the basis of the above discussion, it is recommended that the test procedure be modified in accordance with options 3 and 4 above. That is, the following changes to the test procedure are recommended:

1. Require a back-up filter during actual certification testing.

2. Calculate the ratio of filter weights as indicated in the light-duty diesel NPRM.

3. If the ratio is greater than 0.95, calculate particulate emissions on the basis of the first filter net weight.

4. If the ratio is less than 0.95, calculate particulate emissions on the basis of combined net weights of the first filter and the back-up filter.